

VESSEL, FIRM, AND LOCK EFFICIENCY MEASURES IN LOCK PERFORMANCE

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2006 NETS Symposium

Salt Lake City, Utah

Background

- Most locks on the UMISS more than 50 years old and 600 feet in length
- A majority of “flotillas” are more than 600 feet requiring two cuts which take more than twice as long as a single cut.
- Increased traffic, growing congestion, and the costs of improvements have led to consideration of both structural and non-structural measures to improve the efficiency of the waterways

Purpose

- Develop an econometric model of lock processing times that allows for:
 - Standard and nonstandard explanations
 - Relative efficiency measures by
 - Lock
 - Vessel
 - Firms

The Model(s)

Time to pass the lock (EOL-SOL)

- Number of cuts
- Flotilla characteristics
- Lock Characteristics
- Lockage type
- Vessel Characteristics
- State characteristics
- Fixed effects for locks and vessels
- **MORE LATER**

The Data

- LPMS 2000
- Vessel Characteristics
- Gauge Level Readings
- Lock Characteristics File

NOTE:

- Same lock serves lots of different flotillas
- Same vessel passes through the same or different locks multiple times

This allows the use of panel data techniques to identify lock and vessel unobserved effects.

The Variables

Variable	Description	Overall	Single Cut	Double Cut
Time	Time to Lock	78.9	42.47	110
Cuts	Number of Cuts	1.54	1	2
Barges	Number of Barges	10.71	7.33	13.59
flot_length	Length of Flotilla	922.53	756.45	1064.34
flot_width	Width of Flotilla	93.36	80.01	104.76
flot_depth	Depth of Flotilla (deepest point)	7.41	6.8	7.93
Peremp	Percentage Barges Empty	34.58	38.74	31.03
b_hopper	Percentage of Hopper Barges	84.7	71.1	96.31
b_tank	Percentage of Tanker Barges	12.15	22.63	3.2
b_other	Percentage of Other Barges	3.15	6.27	0.49
Hrp	Horsepower of Power Vessel	4310	3461	5035
Knock	Dummy for Knockout, Setover, Jackknife	9.75	19.91	1.09
Fly	Dummy for Fly Lockage	41.34	46.79	36.69
Turn	Dummy for Turnback Lockage	28.59	28.42	28.74
Exch	Dummy for Exchange Lockage	30.03	24.76	34.53
Upriver	Dummy for Upriver Lockages	49.41	50.05	48.86
Daytime	Dummy for Daytime Lockages	55.36	54.7	55.93
clearance	Clearance over the Sill (Ft)	10.48	12.95	8.38
Obs.	Number of Observations	59,683	27,489	32194

The Results

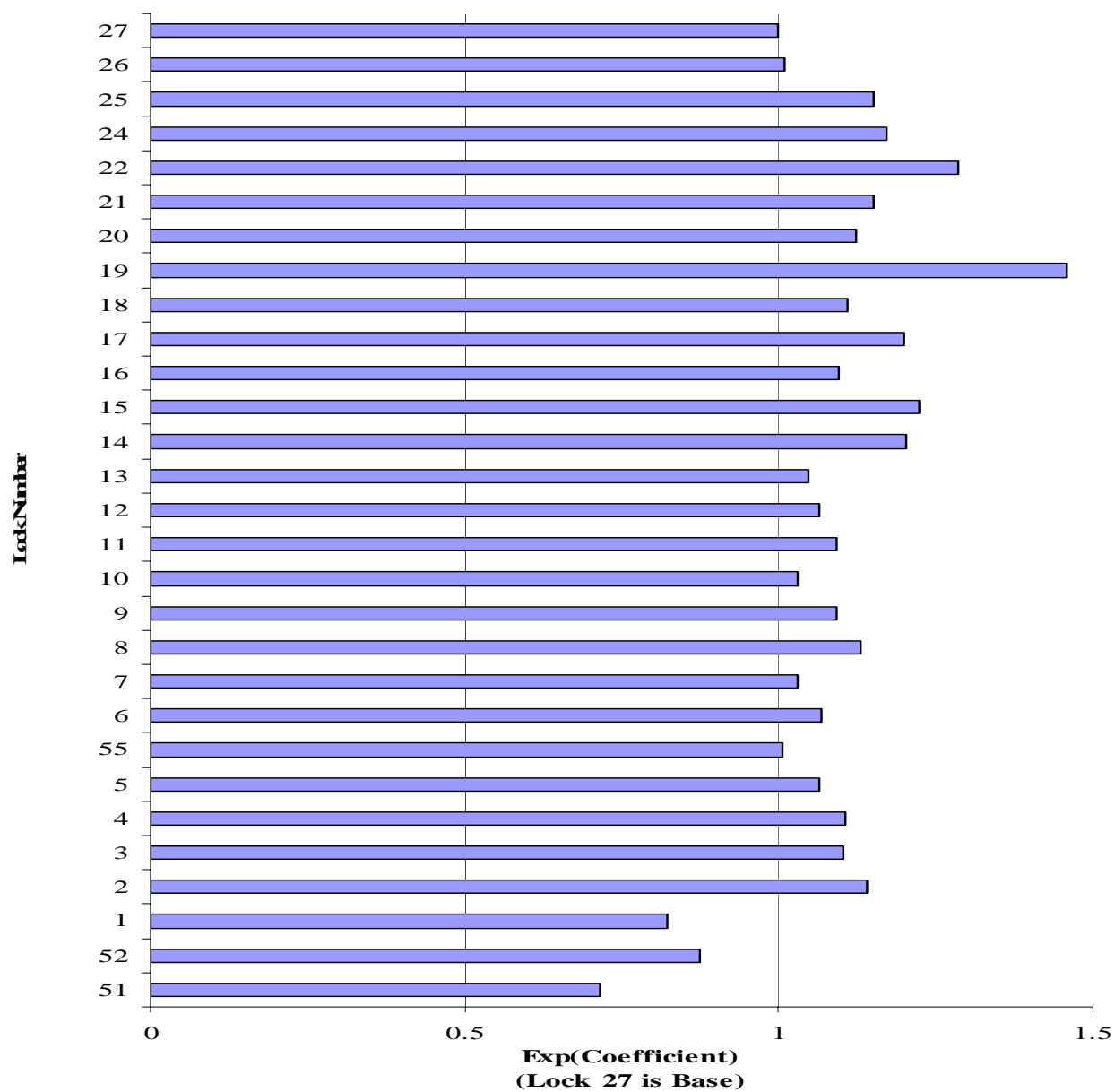
What matters:

Time = Cuts alone	$R^2 =$ 71
+ lock lengths	75
+ dummies for each lock	77

Results

<i>Variable</i>	Base	Lock FE	lock&Vessel FE
Double-Cut (Dummy)	0.748	0.751	0.76
Number of Barges (Log)	0.102	0.11	0.133
Tons per horsepower (Log)	0.062	0.059	0.068
Zero-tons (Dummy, all barges empty)	-0.022	-0.091	-0.086
Turnback lockage (Dummy)	-0.174	-0.196	-0.194
Exchange lockage (Dummy)	0	-0.024	-0.024
Flotilla Length (Log)	0.284	0.27	0.174
Knockout, jackknife or setover lockage (Dummy)	0.182	0.191	0.211
Day-time lockage (Dummy)	-0.058	-0.056	-0.058
Upriver lockage (Dummy)	-0.019	-0.017	-0.014
Clearance (Log)	-0.116	-0.033	-0.027
% tanker barges (Level)	0.138	0.161	0.031
% other barges (Level)	0.003	-0.022	0.02
1200 foot lock (Dummy)	0.014	NA	NA
400 foot lock (Dummy)	-0.38	NA	NA
500 foot lock	-0.008	NA	NA
Intercept	1.876	1.561	2.422
R-squared	0.86	0.88	0.89

Lock FE



Lock FE Explanations

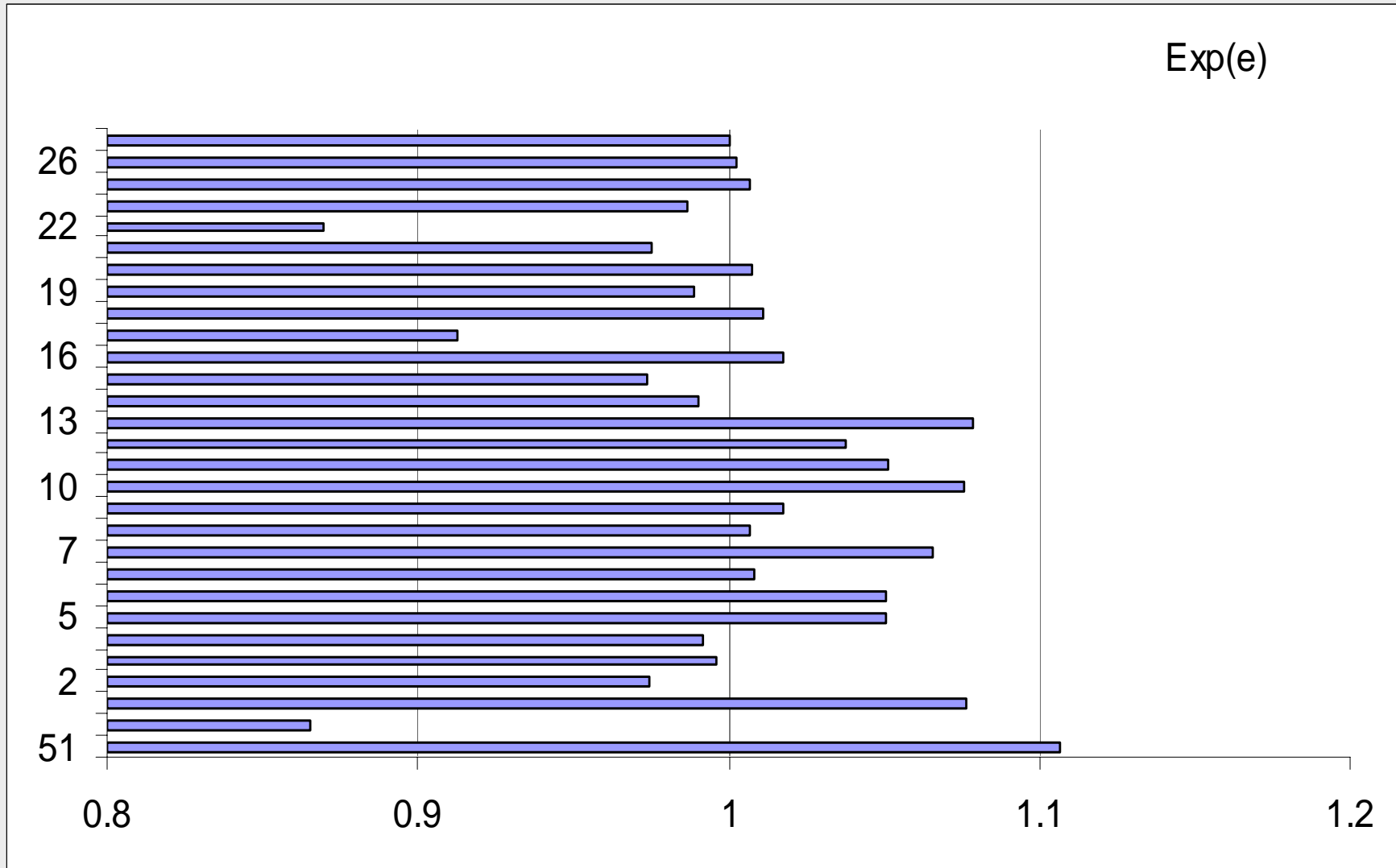
- Saxonhouse (AER) Regression:
 - Regress the FE on lock characteristics (weighted by standard errors of the lock coefficients)

$$\begin{aligned} dummy = & -2.88^* + 0.22^* \log(age) + 0.29^* \log(length) + 0.096^* \log(lift) \\ & (-3.09) \quad (4.82) \qquad (2.27) \qquad (2.06) \end{aligned}$$

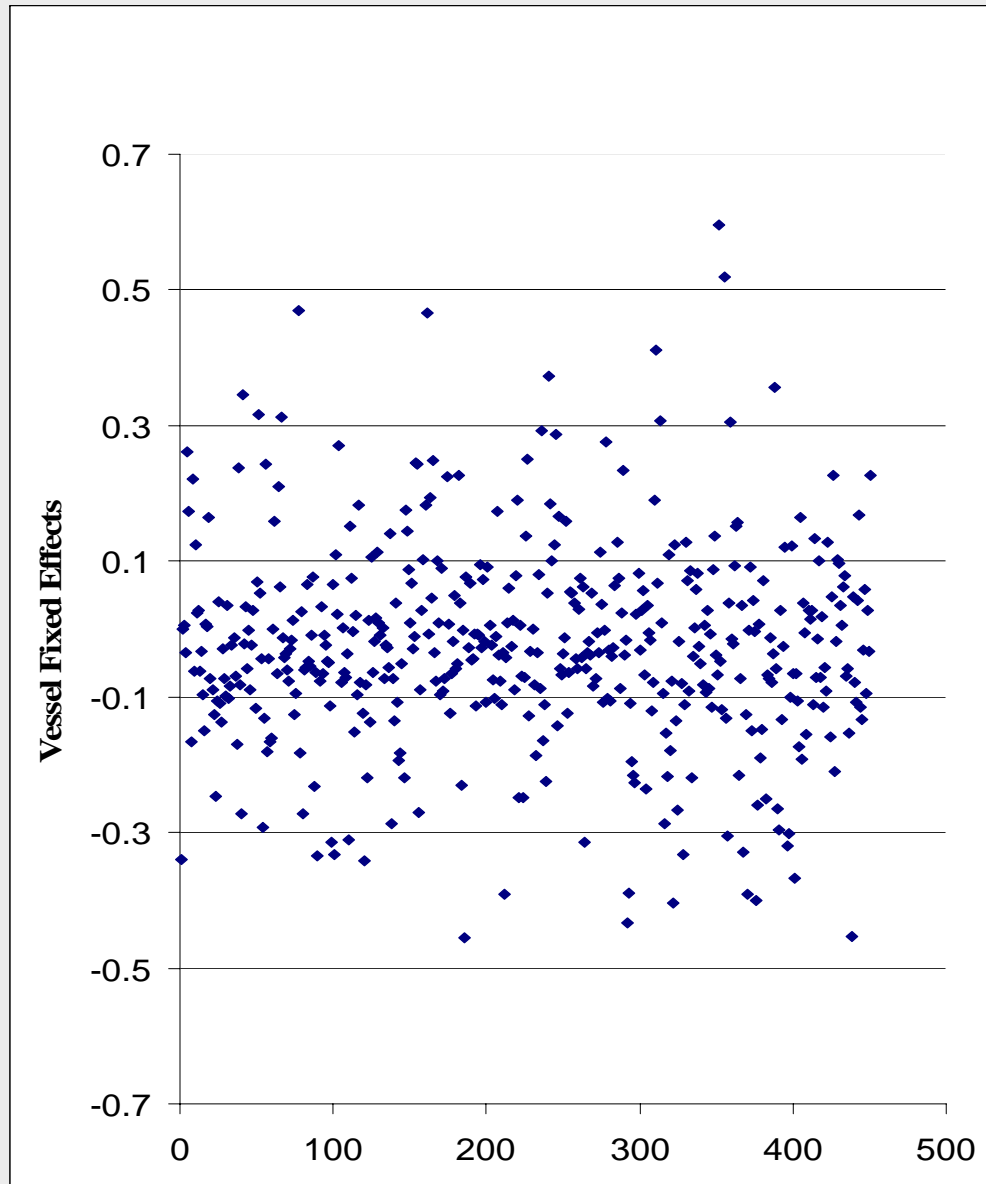
$$\begin{aligned} & -0.004 Moordum - 0.269^* MPLS \\ & (-0.16) \qquad (-2.23) \end{aligned}$$

$$pseudo R^2 = .81$$

- 1 means that the estimated efficiency is the same as implied by the observed factors
1.1 means that the estimated efficiency is 10 percent more
.85 means that the estimated efficiency is 15 percent less



Vessel Fixed Effects



0 means same as base vessel.

Range is $-.45$ to $.59$. The fastest vessel transits at 63% ($\exp(-.45)$) of the base, while the slowest goes 180% ($\exp(.59)$) of the base vessel

Vessel Model

Horsepower	0.041	0.016
	(1.80)	(0.68)
Height	-0.056	0.005
	(-2.84)*	(0.27)
Length	0.035	-0.022
	(0.88)	(-0.49)
Draft (load)	0.101	0.042
	(2.44)*	(0.92)
Age	0.004	-0.010
	(0.37)	(-0.66)
# of Lockages	-0.030	-0.016
	(5.30)*	(-2.89)*
Diversity (inverse measure)	-0.035	-0.017
	(-5.04)*	(-2.18)*
Lockages by Firm	-0.028	NA
	(-4.35)*	
# of Firm Vessels	0.046	NA
	(4.82)*	
Constant	-0.408	-0.126
	(-4.24)*	(-0.72)
Observations	447	447
R-squared	27	62

Firm Fixed Effects

- Marked differences across firms in power vessel effects which explain transit times.
- A larger number means that the power vessel effect is stronger, and processing times are longer.
- The range of values is from $-.41$ to $.53$ which translate into multiplicative factors of $.66$ and 1.71 .
 - Faster firms move at $.66$ of the base firm times
 - Slower firms move at 1.71 of the base firms times.
- Suppose a lockage that takes a vessel by the base firm 50 minutes. The range of times by different firms is 33 minutes to 85 minutes. The result points to tremendous differences across firms in processing times.

